PLASMA-INDUCED ELECTRET CHARGE IN POLYTETRAFLUOROETHYLENE FILMS

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The effect of plasma treatment on the surface properties of PTFE films modified by direct current glow discharge was investigated. The relationship between the formation of the electret states and the contact properties of PTFE films was examined.

The improvement of the contact and adhesion properties of polymers by low-temperature plasma treatment is usually associated with chemical transformations on their surface, such as the formation of chemically different (mainly, oxygen-containing) polar groups. However, no direct correlation between the values of the contact angle, data on the adhesion of plasma-modified polymers and the formation of electret states in the surface layers of the films has been revealed.

Samples of the PTFE film of 40 μm thickness (Russia, "Plastpolymer", St. Petersburg) were modified by DC discharge at the anode and cathode [1]. The surface properties were characterized by the values of the contact angle ($\boldsymbol{\theta}$) of deionized water. The electret potential ($\boldsymbol{U}$) was measured by the compensation technique using a dynamic capacitor. From the measured $\boldsymbol{U}$ value, the effective surface charge density ($\boldsymbol{\sigma}$) was calculated by the equation $\boldsymbol{\sigma = \varepsilon_0 \varepsilon U/L}$. The adhesive properties were investigated according to the procedure described in [2]. The peel strength ($\boldsymbol{A}$) was determined using the T-peel test for the Scotch®810/PTFE film contact.

The results obtained are indicated the existence of an inverse correlation between the contact angle and the peel strength: the less the value of $\boldsymbol{\theta}$, the greater the value of $\boldsymbol{A}$. This relationship is characteristic of the both types of films modified at the anode or at the cathode. It was established that the initial film had a small negative surface potential and the effective charge density of this film is $\boldsymbol{\sigma}$ = –15 μC/m^2. The presence of this potential is apparently due to the sample prehistory. After modifying the film at the anode, the effective density of negative charge increases to $\boldsymbol{\sigma}$ = –36 μC/m^2, whereas the film treated at the cathode acquires a positive surface charge. It was also shown that as the storage time increases the contact angle increases, the peel strength decreases, and the effective surface charge density is reduced. Note that there is the undoubted correlation between the effective surface charge density and $\boldsymbol{\theta}$, as well as between $\boldsymbol{\sigma}$ and $\boldsymbol{A}$.

REFERENCES

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